

Quoting from the Applicant's response dated 12/22/04 " The Applicant states that Horowitz et al. does show an actual organic chemical reaction that does alter the molecular structure of a substance, but there is a difference. The organic chemical reaction is actually the separation of the sulfur atoms atomically bonded with the coal. This sulfur separation is done after the froth flotation is used, and the organic chemical reaction that alters the molecular structure is not done to benefit the froth flotation method of separation. The organic chemical reaction is actually where the separation occurs. In Horowitz et al., the organic chemical reaction actually frees the sulfur from the coal without any real mechanical method of separation. The organic chemical reaction in Horowitz et al. effectively causes an atomic bond separation between atoms of sulfur and molecules of coal. The simple washing can be technically interpreted as a mechanical means of separation, but the Applicant had intended something more substantial as the mechanical means of separation.

This type of separation by an organic chemical reaction is not what the Applicant intended and is not within the scope of the invention. The Applicant is not claiming an invention that uses an organic chemical reaction to separate substances that are atomically bonded together. The Applicant is claiming an invention that uses an organic chemical reaction to alter both the molecular structure and a physical characteristics of a substance that is in a non-atomic bond combination or mixture to then make it possible to use a mechanical means of separation. The Applicant has now tried to amend the claims to accurately reflect the scope of the invention.

An example of the invention would be to have two substances with the same or very close to same, specific gravity. This fact would make it impossible to use specific gravity flotation separation as a method to separate these two substances. This problem can be overcome by using an organic chemical reaction to alter the molecular structure and also the specific gravity (physical characteristic) of one of the two substances. Then the specific gravity flotation separation can be used to successfully separate one substance from the other. This is the scope of the invention claimed, and the claims have been amended to reflect that the invention does not seek to separate substances that are atomically bonded together."

As the Examiner can see the Applicant did not previously **admit** but indeed clearly **stated** that the organic chemical reactions in Horowitz were separating substances that were atomically bonded together and that this was not the scope of the invention claimed. The fact that the Examiner is stating that the organic chemical reactions in Yang are similar to the reactions in Horowitz would mean that the organic chemical reactions in Yang also separate substances that are atomically bonded together. Therefore, the organic chemical reactions in Yang are also not within the scope of the present invention claimed. The amendments to the claims would apply to both Horowitz and Yang. The specifications in Yang clearly state that the impurities such as sulfur are digested or dissolved. The Applicant never intended that removing an atom from a molecular structure meant that the atom would be digested, dissolved or destroyed. The claims will be amended to reflect that the removed atom is not dissolved or destroyed.

B. Patent Borengo et al. is a reference cited by the Examiner as teaching a substance subjected to multiple organic chemical reactions as well as flotation and mechanical separation steps and that the atoms are bonded to the substance via ionic bond prior to mechanical separation. Borengo contains froth flotation as the mechanical means of separation. Froth flotation is described in Bulatovic et al. 2<sup>nd</sup> paragraph of the specification (enclosed page). Froth flotation does not require an alteration of a molecular structure. Froth flotation is different from specific gravity flotation and was not a mechanical method of separation the applicant intended for the invention claimed. As explained in Bulatovic et al. froth flotation is a surface treatment. Any oxidation occurring has to do with the state of the valence electrons and does not alter the molecular structure of any substance in the combination or mixture.

Evidence that patent Borengo uses froth flotation is found throughout the specifications of Borengo. In column 1 paragraph 2 "whereas the ionizable chemical collecting agents are employed for all other mineral species on whose surfaces said agents become adsorbed by bonds substantially of a chemical type", in column 1 paragraph 3 "collecting agent action", and in column 1 paragraph 7 "chelating agents". There is adhesion going on but not chemical bonding. Adsorption is defined as "The adhesion, in an extremely thin layer, of the molecules of gases, of dissolved substances, or of liquids, to the surfaces of solid bodies with which they are in contact." The adhesion of molecules to a solid surface such as lead or zinc is not a chemical bond and therefore, no molecular structure is altered in Borengo.

Column 3 paragraph 2 "It is to be observed that the collecting agents for flotation processes which are taken into consideration in the process according to the present invention, are only those capable of forming with metals water insoluble compounds. In said compounds, the metal ion is bonded to the organic molecule through ionic bonds as well as through a donor type bond; the association between the metal and the collecting agent occurs so that the coordination number and the electric charge of the metal are balanced respectively by the sum of the donor groups and of the ionic charges of the collecting agent with which the metal combines." The Examiner marked this paragraph as if it proved that a molecular structure had been altered by an organic chemical reaction. The paragraph is describing what kind of compound is required for the invention claimed in Borengo. The paragraph describes the metal ion bonded to the organic molecule **before** the collecting agent is added. The fact is that combining of the collecting agent and the metal ion is described as an **association**, not as a chemical bond. This association is the adhesion of the collecting agent to the surface like tape would stick to a piece of wood and the molecular structure of the tape or the wood is not altered.

Column 4 paragraph 8 under flotation the reagent introduced is a frothing agent and air is used to help for foam that will cause the ore to float. There is no altering of the molecular structure or even the actual specific gravity of any substance. Just like attaching balloons of air to anything can make it float. It is the buoyancy of the air that overcomes the specific gravity but does not change the specific gravity of the object. Nor does it change the molecular structure.

The present invention claimed by the Applicant specifically stated in the specification of the original application filed that froth flotation was not being claimed in the application.

The reasons were that no altering of a molecular structure needs to occur because it is a surface treatment only and no physical characteristic of a substance is altered. Froth flotation as presently described in all the known prior art is not within the scope of the present invention claimed by the Applicant. Despite this fact the Applicant will amend the claims in a way that specifically excludes froth flotation from the claims.

3. The Examiner has pointed out that the specifications contain only examples of organic chemical reactions and thus, under patent law the Applicant cannot claim just a chemical reaction. **The Examiner is quite correct on this fact.** The Applicant will amend the claims to reflect only organic chemical reactions. **The Applicant appreciates the Examiner's assistance.**

4. The Examiner also pointed that the claims should be in double-space format and that some of the Applicant's previous corrections were unclear. The Applicant will amend the claims in the appropriate manner. **The Applicant once again thanks the Examiner for the assistance.**

5. Enclosed are pages 1-3 of Applicant's response, page 1 of Bulatovic specification, and pages 1-3 of Borengo specification.

6. To avoid any claims correction confusion the Applicant has canceled claims 1-38 and submitted new claims 39-59.



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## SEPARATION OF POLYMETALLIC SULPHIDES BY FROTH FLOTATION

Froth  
Flotation

This invention relates to the separation of sulphidic minerals by froth flotation in a mineral separation process. More particularly this invention relates to the separation of sulphidic minerals present in polymetallic sulphides by differential froth flotation.

Froth flotation is a well-known mineral processing operation for obtaining mineral concentrates of a desired compound or element. In this process a collector agent is added to the aqueous slurry of the ground ore. The collector agent for a particular mineral is preferentially adsorbed on the surface of the mineral particles containing the desired compound, thereby rendering the surface hydrophobic (non-wetting by water). In a flotation device and in the presence of a frothing agent, air bubbles will be attached to the particles of the desired mineral thereby lifting them to the surface of the slurry. The froth in most instances is collected by mechanical means. The separated froth is usually dried or dewatered, and the concentrate is treated in subsequent steps to recover the desired compound or element.

In addition to collector and frothing agents being added to an ore slurry in the mineral separation process, it is usual to add depressant agents, which will be adsorbed on the surface of particles containing unwanted compounds. The surface of the particles are thereby rendered wettable, i.e., hydrophilic and hence not floatable. The unwanted minerals may contain minerals bearing certain compounds which are to be recovered by subsequent flotation process steps, by means of additions of a collector agent specific to such a mineral. When two or more flotation circuits are operated sequentially to selectively separate desired compounds present in ores, the process is referred to as differential flotation.

The usual practice of differential flotation is to treat the ore pulp similarly to a single flotation circuit but with reagents which will permit the flotation of only one of the desired minerals by preventing or minimizing flotation of other minerals. The residue from the first flotation stage is then treated with one or more chemical reagents to bring about flotation and concentration of a second mineral. In the second flotation process the desired minerals contained in the froth will provide a concentrate of minerals which have been separated from the minerals contained in the concentrate of the first flotation step. The residue or tailing of the second flotation process step thus will contain the unwanted minerals separated from the two desired minerals present originally in the ore. Of course, more than two flotation process circuits may be introduced sequentially to result in more than two concentrates of compounds and minerals which are of use to the mineral processor.

The concentrates obtained still contain unwanted compounds, but have been substantially enriched in the desired compound or element, thereby reducing the cost of further recovery steps. It is customary to refer to the compound of metals in an ore which are to be recovered from the ore under treatment as value metals.

Massive sulphidic ores usually contain sulphides of three or more metals which are to be separated and recovered by separate process steps. Most massive sulphides contain iron sulphides which are intimately mixed and disseminated throughout the ore. The iron

sulphides, quartz, silicates, are usually of no value to the metallurgist and are to be separated from the value metals and discarded. It is of great significance for economical metal recovery, that the value metals be separated into concentrates of specific metals at the early stages of the metal recovery process. The separation of value metals into concentrates is often conducted by differential flotation circuits and the final tailing, or the combined tailing of differential flotation circuits will be separated and discarded as containing various gangue minerals.

The differential flotation is usually achieved with additions of various inorganic and organic chemicals called modifiers and depressants which alter the surfaces and flotation properties of the sulphides which need to be separated. There are known collector agents for the flotation separation of copper, nickel, zinc, lead, contained in sulphidic ores but these may not be selective enough, often allowing significant portions of one value metal retained in the concentrate of another value metal. In other words, the selectivity of the collector agent is not sufficiently high. There are known depressant agents which may increase the selectivity of a collector agent, but the improvement may still not be sufficient to render the separation process economical. It may often happen that a collector-depressant combination may provide good separation in one type of sulphidic ore, but will be much less effective in the case of sulphidic ore of a different origin and nature.

By way of illustration of lack of selectivity, various sulphates of heavy metals such as zinc sulphate as well as cyanide, are used for the depression of sphalerite (ZnS) during the differential flotation of copper-zinc sulphides or copper-lead-zinc sulphidic ores. Cyanide and lime are used to separate chalcopyrite from pentlandite. In actual practice, even with additions of known depressants the sharpness of separation in complex ores of lead, copper, zinc from iron sulphides, copper-zinc sulphides or copper-nickel sulphides is often poor and results in losses in mineral values thereby substantially increasing the cost of the recovery process.

There is a need for a depressant agent which will increase the selectivity of known collector agents in the differential flotation separation of complex sulphidic ores containing copper sulphides as well as lead, zinc, and iron sulphides intimately mixed with each other.

There is also a need for a depressant agent which will increase the selectivity of known collector agents in the differential flotation separation of value metals contained in mixed sulphidic ores containing copper-nickel-iron, or copper-zinc-iron.

A new depressant has been found for the enhanced separation of metal sulphides contained in mixed polymetallic sulphidic ores consisting of:

- (i) quebracho chemically reacted with one of the group consisting of: guar gum, and dextrin.
- (ii) a water soluble salt of lignin sulphonate; and
- (iii) at least one of the group consisting of alkali metal cyanide, alkaline earth metal cyanide, water soluble metal sulphate, and a water soluble metal sulphite containing a tetravalent sulphur atom.

### BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic flowsheet representing a differential flotation separation process.

A detailed description of the preferred embodiment of the invention will be provided hereinbelow and illus-

# COLLECTING AGENTS FOR THE SELECTIVE FLOTATION OF LEAD AND ZINC ORES

## DISCLOSURE OF THE INVENTION

The present invention relates to organic ionic collecting agents for the selective flotation of lead and zinc metal ores.

As is well known in the prior art, collecting agents known or employed at the present time can be classified into two categories: the ionic and the non ionic collecting agents. The employment of neutral or oil collecting agents is generally limited to the flotation of nonpolar minerals on which said agents become adsorbed by forces of a physical type or van der Waals forces, whereas the ionizable chemical collecting agents are employed for all other mineral species on whose surfaces said agents become adsorbed by bonds substantially of a chemical type. Chemical absorption is indeed more selective than physical adsorption, but it is to be observed that ionic collecting agents are also active towards some well determined mineral classes (as for instance sulfides), but said ionic agents do not display any selective capability towards a single mineral species.

Thus, it is necessary to employ some modified compounds in order to carry out the flotation of a given mineral from a mixture of minerals belonging to a given class, said modifiers making the collecting agent action much more specific, as is well known.

However, the use of such reagents brings about considerable drawbacks quite often and it does not give the desired result each time, especially when such reagents are employed for minerals of a complex chemical composition and whose surface properties are not sufficiently known.

Thus, it is clear that the possibility of employing collecting agents capable of bonding with some determined minerals in a selective way would be very useful. Such possibility implies the presence within the structures of said collecting agents of active groups having a specific affinity towards some specific cations which are characteristic of the mineral surface.

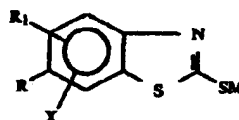
Assuming that a close correlation exists among the phenomena occurring in solution which involve actual chemical reactions and the phenomena occurring on the mineral surfaces, the possibility has been advanced according to the present invention of exploiting for the flotation process some ionic organic reagents which at the present time are considered with an increasing interest in analytical chemistry, because of their features of specific or highly selective action towards some given inorganic ions, and particularly towards some metal ions.

Such reagents are well known in analytical chemistry as "chelating agents". They are organic compounds which are capable of linking to some specific metal ions at a number of sites of their molecules with the formation of one or more rings that give the compound a very high stability.

Very rare and general information is available as regards the employment of such reagents in flotation processes, and such information comes in most cases from technical papers or operations of many years ago. For instance, Gutzelt employed chelating agents in the anionic flotation of the oxidized minerals of iron as sequestering agents for the heavy metal ions in order to prevent quartz from being floated. On such bases, the

present invention solves the problem of obtaining the hydrophobic character of the mineral particles to be floated advantageously by introducing hydrocarbon groups as functional groups into some classes of organic chelating agents to be exploited as collecting agents for flotation processes.

Accordingly, it is an object of the present invention to supply a class of ionic organic collecting agents which are selective in the flotation of lead and zinc ores, and have the following general formula:



(I)

wherein the symbols employed have the following meanings:

R represents an alkoxyl group having from 3 to 12 carbon atoms;

R<sub>1</sub> represents H, a linear or branched chain alkyl group, an alkoxyl or hydroxyalkyl group containing up to 12 carbon atoms;

X represents H, Cl, Br, I, F, CN, CONH<sub>2</sub>, NO<sub>2</sub>, SO<sub>2</sub>NH<sub>2</sub>;

M represents H, Na, K, Li, Ca.

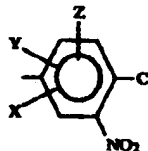
The collecting agents of the present invention are preferably suitable for the flotation of cerussite, galena, smithsonite, hemimorphite, zinc blende and the like.

The class consisting of the selective collecting agents for flotation corresponding to the general formula (I) which are the object of the present invention has not been disclosed up to the present time, even though some compounds are known which are derivatives of the 2-mercaptobenzothiazole, which have a limited application as reagents for analysis or as accelerating agents for vulcanization of rubber. Moreover, no information is available at the present time as to the employment of compounds corresponding to the general formula (I) in the field of the selective collecting agents for the flotation of lead and zinc ores.

The possibility of synthesizing ionic collecting agents of notable characteristics for the selective flotation of lead and zinc ores such as those of formula (I) obtained according to the present invention is quite unforeseeable for those skilled in the art, as is evident from the facts mentioned above.

This and other objects of the present invention can be obtained by means of the compounds of the general formula (I).

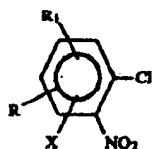
As an illustration, said compounds can be obtained through a process in which a derivative of the formula:



(II)

wherein X has the same meaning as given above, Y and Z, which can be the same or different from each other represent H, —OH, —CHO, is reacted with a linear or

branched alkyl halide so as to obtain a compound of the formula:



wherein X, R and R<sub>1</sub> have the same meaning as given above, which compound is then treated with sodium polysulfide so as to transform the same into the ortho-amino-mercapto-derivative and carbon disulfide in order to transform it by cyclization into a 2-mercaptobenzothiazole with the substituent groups X, R<sub>1</sub> and R<sub>2</sub> as shown in the general formula (I).

It is to be observed that the collecting agents for flotation processes which are taken into consideration in the process according to the present invention, are only those capable of forming with metals water insoluble compounds. In said compounds, the metal ion is bonded to the organic molecule through ionic bonds as well as through a donor type bond; the association between the metal and the collecting agent occurs so that the coordination number and the electric charge of the metal are balanced respectively by the sum of the donor groups and of the ionic charges of the collecting agent with which the metal combines.

Thus, it was made clear according to the present invention that the properties of the reagents in question are better with respect to those of common collecting agents, such properties differing from those of the latter above all as regards the high specific character towards metal ions, and as regards the structural differences of their nonpolar portions.

Hence the present invention allows to obtain improved organic ionic collecting agents for the selective flotation of metal minerals, particularly of structurally complex minerals, for instance lead and zinc minerals, which give a number of difficulties in the selective flotation.

Such collecting agents were shown to be of a high importance from the practical as well as from the economic viewpoint.

More particularly, the choice of a collecting agent for each mineral type was determined by its capability of giving chelation compounds which are insoluble with cations making part of the composition of the mineral itself.

Experimental tests were carried out in order to obtain all data inherent to the present invention according to the principles of analytical chemistry, so that the pH values and the collecting agent concentration were found at which the flotation process of said lead and zinc ores gives satisfying results.

Next the changes were studied for each mineral in the recovery within the full range of the pH values, keeping the concentrations of the collecting agents fixed at the values obtained in the experimental tests mentioned above.

In such a way that optimal pH value for the flotation operations was determined with a very high precision.

Flotation condition were set forth for all minerals under which a quite full recovery was obtained in the presence of the collecting agent.

Such conditions are similar to those in which the quantitative precipitation is carried out of the cation in

question according to the principles of analytical chemistry.

All that shows again the possibility of transposing the principles that govern the reactions in solution to the phenomena occurring on surfaces, and in addition all that confirms the validity of the hypothesis that forms the basis of the procedure according to the present invention.

Again according to the present invention it was also found that, when a linear or branched alkyl hydrophobic chain, an alkoxy or a hydroxyalkyl group containing a number of carbon atoms up to 12, are introduced into an aromatic molecule containing two chelating functions ( $-N=$  and  $Sm$ ) at a "beta" position, with a salt-forming chelating activity and some further substituent groups, said aromatic molecule gives by itself the features that are separately given by the chelating agents and by the oil.

This invention will be disclosed in the following by means of application and preparation examples of said collecting agents, said examples being given merely as illustrative examples and not for limitative purposes of the spirit and scope of the present invention.

The general conditions for flotation tests employed and illustrated in the examples given below are the following:

Grinding: a sample weighing 900 g was taken from a rough ore coming from Caltas (Sardinia) and crushed and granulated down to a size lower than 3 mm, then said sample was placed into a laboratory rod mill together with 900 g of tap water, and the whole was ground for a time sufficient to obtain the reduction of 90% of the sample to sizes lower than 100 microns, and finally extracted and diluted with 3 liters of water.

Cyclone treatment: the sample from the grinding step was treated within a Raffinot microcyclone with a vertex hole of 1.5 mm and under a pressure of 1 atmosphere. That operation eliminated a fraction of the ore corresponding to about 15% of the total sample, with particle sizes whose 90% was lower than 12 microns. The fraction whose 80% was of particle sizes between 10 and 100 microns was treated by flotation; material balances were set forth by reference to such fraction.

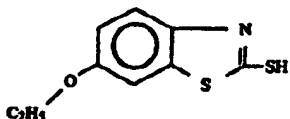
Flotation: the sample free from the fines and coming from the cyclone treatment was introduced into a 2 liters cell that made part of a Humboldt-Wedag flotation apparatus and stirred by means of the rotor of said apparatus. While keeping the air inlet valve closed, one of the collecting agents under test was added and allowed to condition for two minutes, and thereafter a reagent was introduced for foam production (a frothing agent). At the end of the conditioning period, during which the pH value was continuously controlled, the air suction valve was opened and the speed of the rotor was adjusted at 1,200 revolutions/minute, so as to obtain a foam carrying the ore which was removed manually by means of a small shovel till exhaustion of said foam, or, in case of persistency of the same, till the absence of the ore in the foam itself. The product of this step has been called in the examples "the product". The ore part remaining within the flotation cell was called "the waste".

Reactants: the collecting agents in question, added as 2% water solutions, unless specified otherwise.

Reactant proportions: the proportions of the reagents are given as g/tonne (i.e., g of the reactive agent per tonne of the solid).

## EXAMPLE 1

The preparation of a collecting agent for flotation of the formula



by synthesis according to R. F. Dumbrook.

60.6 parts of sulfur and 200 parts of water were added to 228 parts of sodium sulfide ( $\text{Na}_2\text{S} \cdot 9\text{H}_2\text{O}$ ). The mixture is stirred and heated till complete dissolution. 6.5 parts of 5-ethoxy-2-nitrochlorobenzene and 48 parts of carbon disulfide are then added to the polysulfide solution. The solution is heated to  $80^\circ\text{--}85^\circ\text{C}$ . for 4 hours (the reaction course is checked by thin layer chromatography).

When the reaction is over, the excess carbon disulfide is removed by distillation and the mass reacted is diluted with water till a volume of 1 l. This volume is cooled down to  $20^\circ\text{C}$ . and then the product (6-ethoxy-2-mercaptobenzothiazole) is precipitated with 1/1 diluted hydrochloric acid.

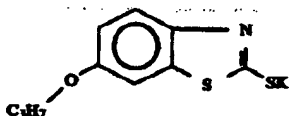
After filtration the product is purified by dissolving the same in a solution containing 800 parts of water and 20 parts of sodium hydroxide.

After filtration the product is dried in a vacuum oven at  $45^\circ\text{C}$ .

4.8 parts of the dried product are obtained.

## EXAMPLE 2

Preparation of the collecting agent for flotation of the formula:

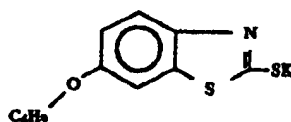


7.62 Parts of sodium sulfoxyanide and 40 parts of glacial acetic acid are added to 5.6 parts of para-propoxyaniline. 12.1 parts of cupric chloride dissolved in 25 parts of ethanol are dropped into this mixture at room temperature and with stirring, then the mixture is heated up to  $70^\circ\text{C}$ . for 90 minutes and thereafter up to  $100^\circ\text{C}$ . for 30 minutes. 80 parts of diluted hydrochloric acid are introduced dropwise into said mixture while it is hot and under stirring. After filtering, the solution is treated at  $40^\circ\text{C}$ . with 0.4 parts of activated carbon. After filtration the intermediate product is precipitated by adding about 60 parts of sodium carbonate. The filtered material is refluxed for 6 hours with 100 parts of a 50% potassium hydroxide solution. The mixture is cooled down to room temperature and 15 parts of carbon disulfide are added dropwise to the same while stirring. Then the mixture is heated up to  $70^\circ\text{C}$ . for 2 hours. After filtering and drying, 3 parts are obtained of the potassium salt of the 2-mercapto-6-propoxybenzothiazole.

The yield, with respect to para-propoxyaniline is 45%.

## EXAMPLE 3

Preparation of a collecting agent for flotation of the formula:



6 Parts of para-butoxyaniline are added to 30 parts of sulfur monochloride. The mixture is first stirred at room temperature for 3 hours and then at  $70^\circ\text{C}$ . for 2 hours.

The excess sulfur monochloride is distilled under vacuum, and thereafter the addition is performed of 100 parts of water, 50 parts of ethanol, 12 parts of sodium hydroxide and 5 parts of sodium hydrosulfite. The mixture is first stirred at room temperature for 3 hours and then at  $50^\circ\text{C}$ . for 1 hour. 15 parts of carbon disulfide is added dropwise at room temperature portionwise. The mixture is heated up to  $70^\circ\text{C}$ . for 1 hour. 2.9 parts is obtained of the potassium salt of 2-mercapto-6-butoxybenzothiazole after filtration and drying.

The yield with respect to para-butoxyaniline is 40%.

Data are reported in the following as relative to the activities of the collecting agents corresponding to the formulas (a) and (b).

The collecting agent of example 1

Raw ore processed: Lead, 4.5%; zinc, 7%. Main minerals in the gangue: calcite, dolomite, quartz.

(a) The reactants:

Collecting agent: 200 + 150 + 150 g/tonne

Aerfroth 65: 6 g/tonne

pH = 7.5

Results obtained:

	Weight %	Pb concentration, %	Pb recovery, %	Zn concentration, %	Zn recovery, %
"product"	15.24	25.60	86.96	5.92	13.31
"waste"	84.76	0.69	13.04	6.93	86.69

(b) The reactants:

Collecting agent: 400 g/tonne

Aerfroth 65: 6 g/tonne

pH = 8

Results:

	Weight %	Pb concentration, %	Pb recovery, %	Zn concentration, %	Zn recovery, %
"product"	17.01	20.59	91.22	5.80	12.66
"waste"	82.99	0.41	8.78	5.58	87.34

The collecting agent of example 2.

Raw ore processed: the same as that of example 1

The reactants:

Collecting agent: 500 g/tonne

Aerfroth 65: 20 g/tonne

pH = 7.8

Results:

	Yield %	Pb concentration, %	Pb recovery, %	Zn concentration, %	Zn recovery, %
"product"	9.19	35.70	82.06	7.76	9.29

## **Conclusion**

The Examiner had rejected claims 18,19, 22, 23, 27, and 28 as being anticipated by Yang. The Applicant demonstrated that the organic chemical reactions in Horowitz were separating substances that were atomically bonded together and that this was not the scope of the invention claimed. The Examiner stated that the organic chemical reactions in Yang are similar to the reactions in Horowitz that means that the organic chemical reactions in Yang also separate substances that are atomically bonded together. Therefore, the organic chemical reactions in Yang are also not within the scope of the present invention claimed. The previous amendments to the claims would apply to both Horowitz and Yang. The specifications in Yang clearly state that the impurities such as sulfur are digested or dissolved. The Applicant never intended that removing an atom from a molecular structure meant that the atom would be digested, dissolved or destroyed. The claims will be amended to reflect that the removed atom is not dissolved or digested.

The Examiner had rejected claims 18, 19, 24 and 29 as being anticipated by Borengo. The Applicant demonstrates that Borengo utilizes froth flotation and the chemical reactions in Borengo did not alter the molecular structure of any substances. The only alteration is to increase the surface adhesion affinity for lead and zinc so that the addition of air foam will float the material to the surface of the water. The present invention claimed by the Applicant specifically stated in the specification of the original application filed that froth flotation was not being claimed in the application. The reasons were that no altering of a molecular structure needs to occur because it is a surface treatment only and no physical characteristic of a substance is altered. Froth flotation as presently described in all the known prior art is not within the scope of the present invention claimed by the Applicant. Despite this fact the Applicant is amending the claims in a way that specifically excludes froth flotation from the claims.

The Examiner had allowed claims 20 and 31-38. The Applicant has submitted new claims in double space format with the proper amendments.



### **Request for Constructive Assistance**

The Applicant understands how important to the continued legal viability of the patent that scope of the invention be reflected in the claim and not just in the intentions of the Applicant. To this end the Applicant wishes to thank the Examiner for his excellent constructive assistance. The undersigned has made a diligent effort to amend the claims of this application so that they will comply structurally and in light of prior art. If, for any reason, the claims of this application are not believed to be in full condition of allowance, applicant respectfully requests the constructive assistance and suggestions of the Examiner in drafting acceptable claims pursuant to MPEP 707.07(3) or in making constructive suggestions pursuant to MPEP 706.03 (d) in order that this application can be placed in allowable condition as soon as possible and without the need for further proceedings.

Very Respectfully,

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I hereby certify that this  
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